EUV enables single exposure 14nm node

First NXE:3300B exposures at ASML

14nm node M1 clip, 46nm minimum pitch, exposed on an NXE:3300B with conventional illumination. Clip courtesy of ST

EUV	ArFi
Single exposure without OPC already shows good resemblance between reticle and wafer layout	Can only be done with double patterning (LELE)
Best HV focus difference <10nm	Best HV focus difference up to 60nm
Measured UDoF of 100nm	Typical UDoF ≈ 50nm

The NXE:3100 has exposed >23000 wafers

Increasing output per quarter

All six NXE: 3100 systems are exposing wafers

Total wafers exposed per quarter

8000
7000
6000
5000
4000
3000
2000
1000
0

Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q32

2010 2011 2012

Contents

NXE:3100 achievements

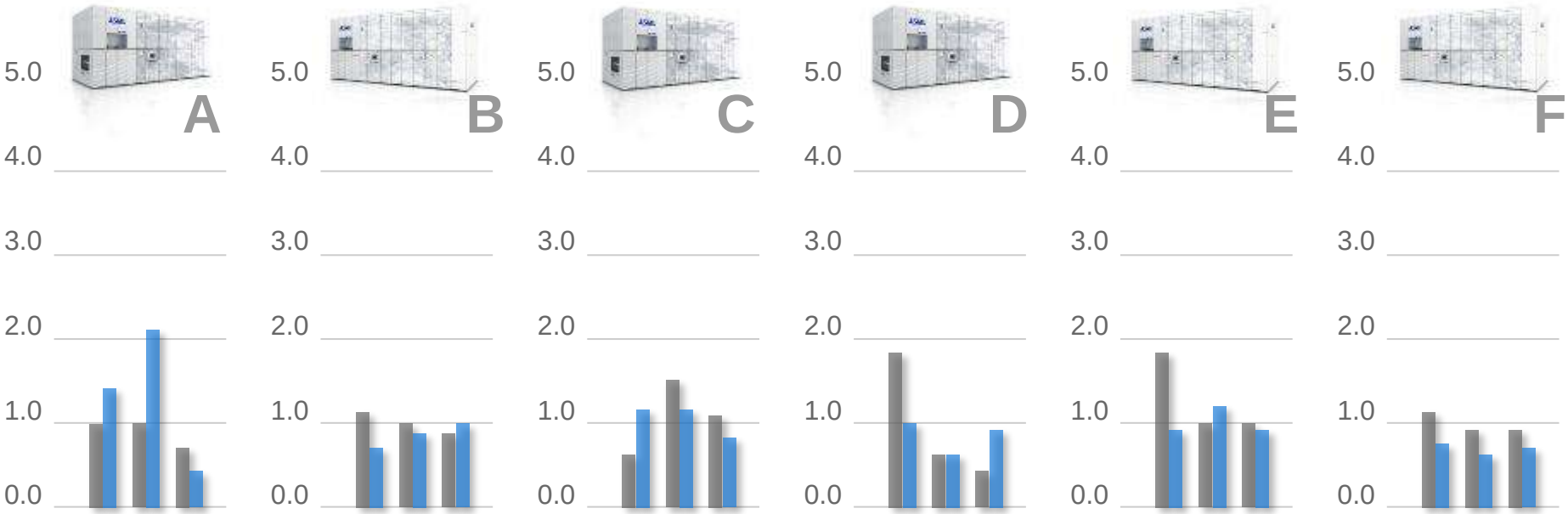
- Productivity
- **Overlay**
- Imaging

NXE:3300B status

Summary

NXE:3100: consistent good overlay on all tools

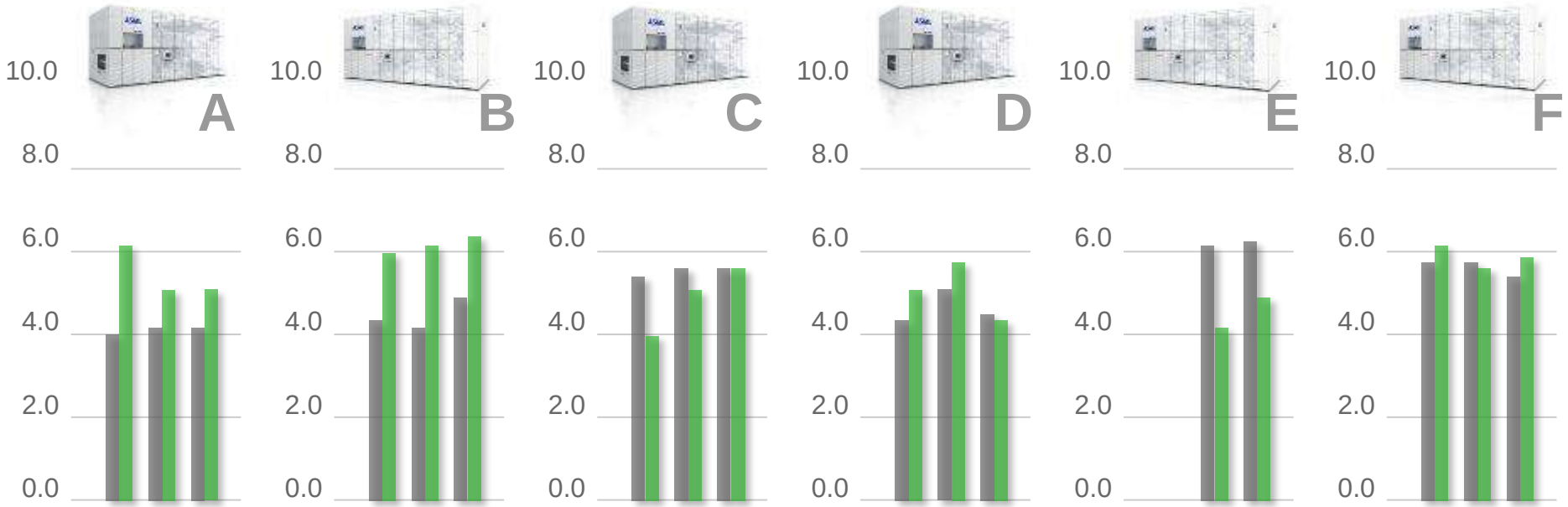
Single Chuck Overlay less than ~2nm



All numbers are (X,Y) single chuck overlay results using ASML standard test method

NXE:3100: consistent good overlay on all tools

Matched Machine Overlay ~6 nm



All numbers are (X,Y) matched machine overlay results to an ArF reference wafer using ASML standard test method

Contents

NXE:3100 achievements

- Productivity
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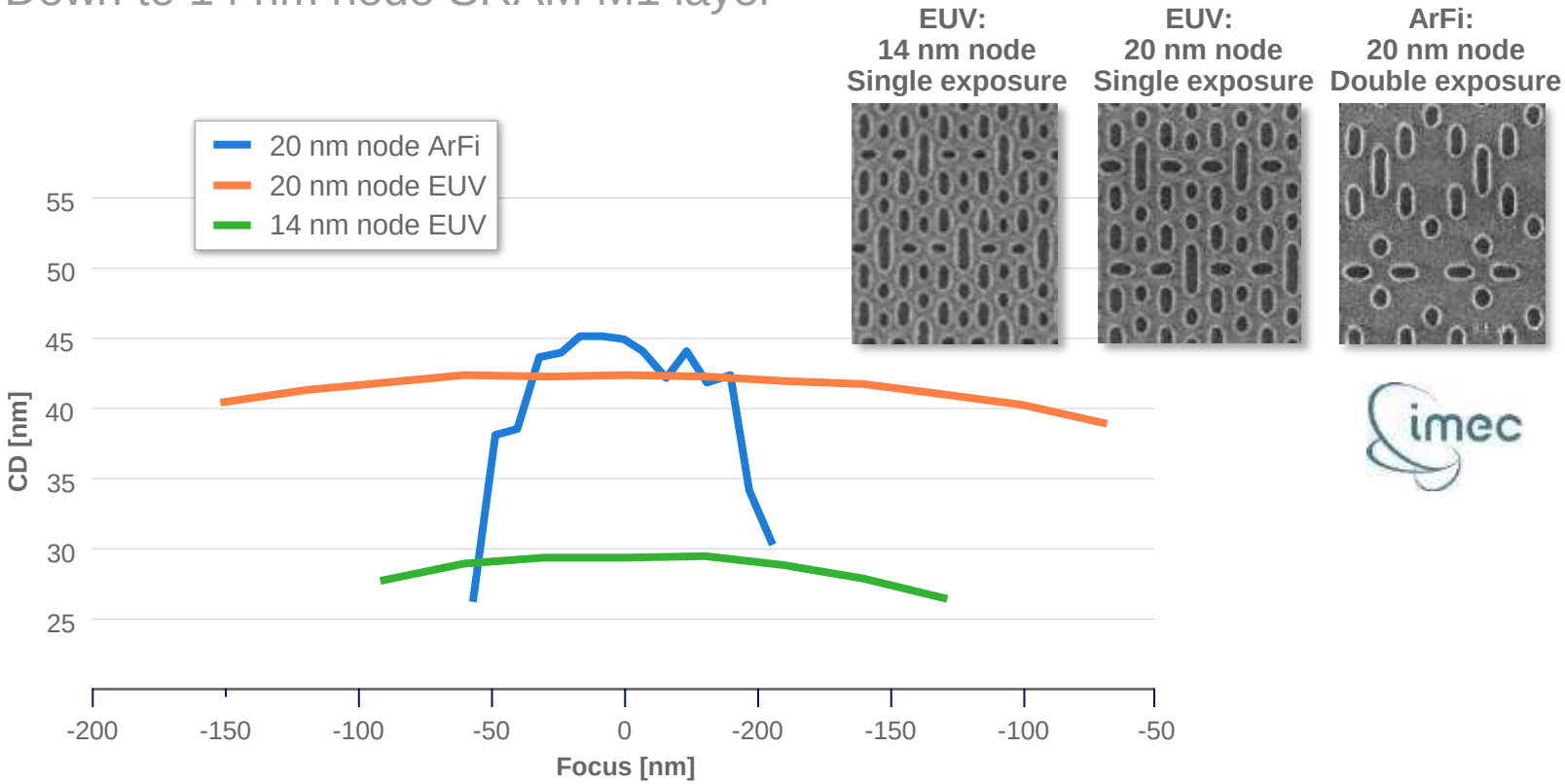
- **Imaging**

NXE:3300B status

Summary

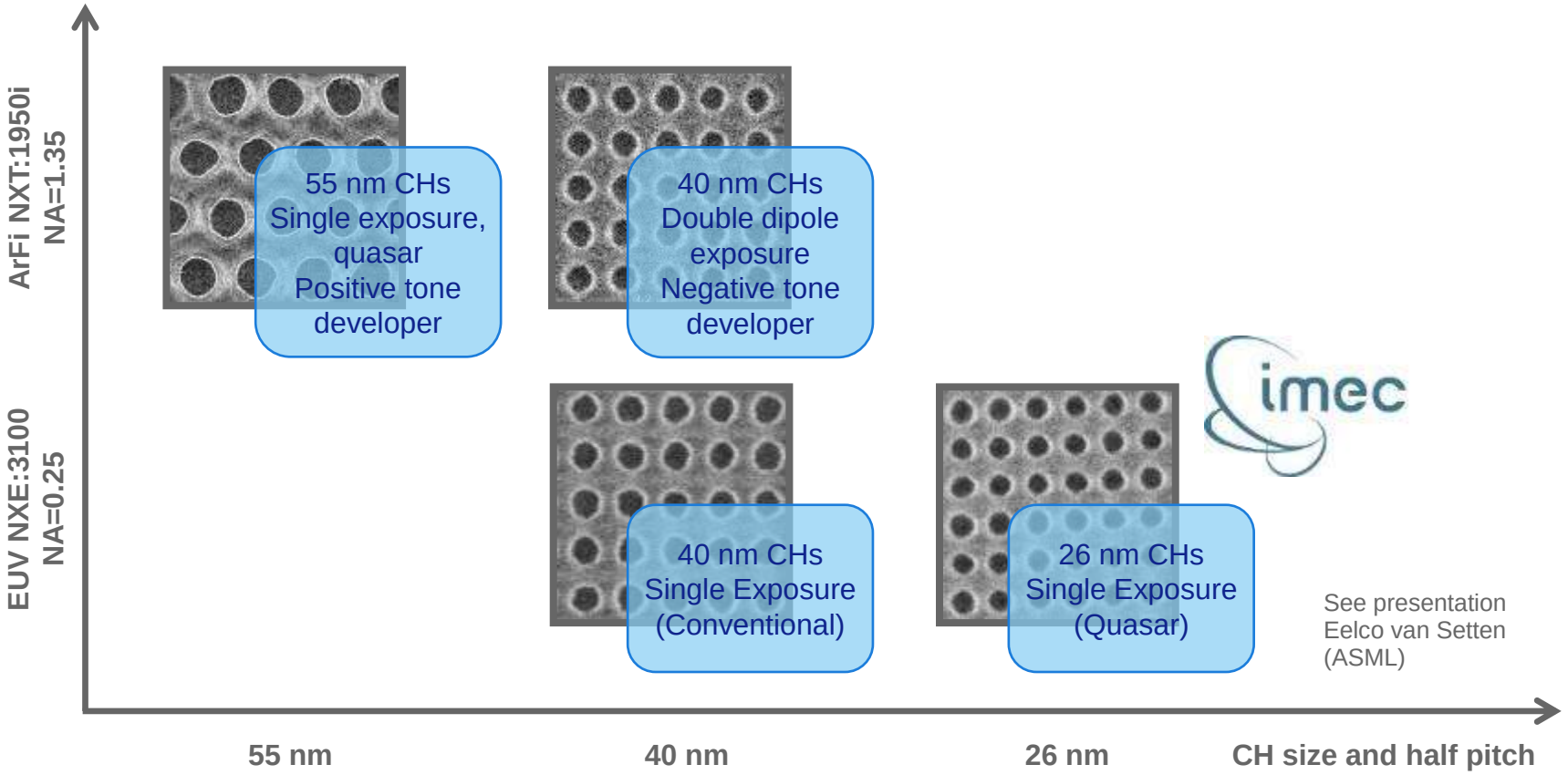
Large process windows measured on the 3100

Down to 14 nm node SRAM M1 layer



See presentation Eelco van Setten (ASML)

Dense CH imaging down to 26 nm on NXE:3100



Contents

NXE:3100 achievements

NXE:3300B status

- **Overview**
- Productivity
- Overlay
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Summary

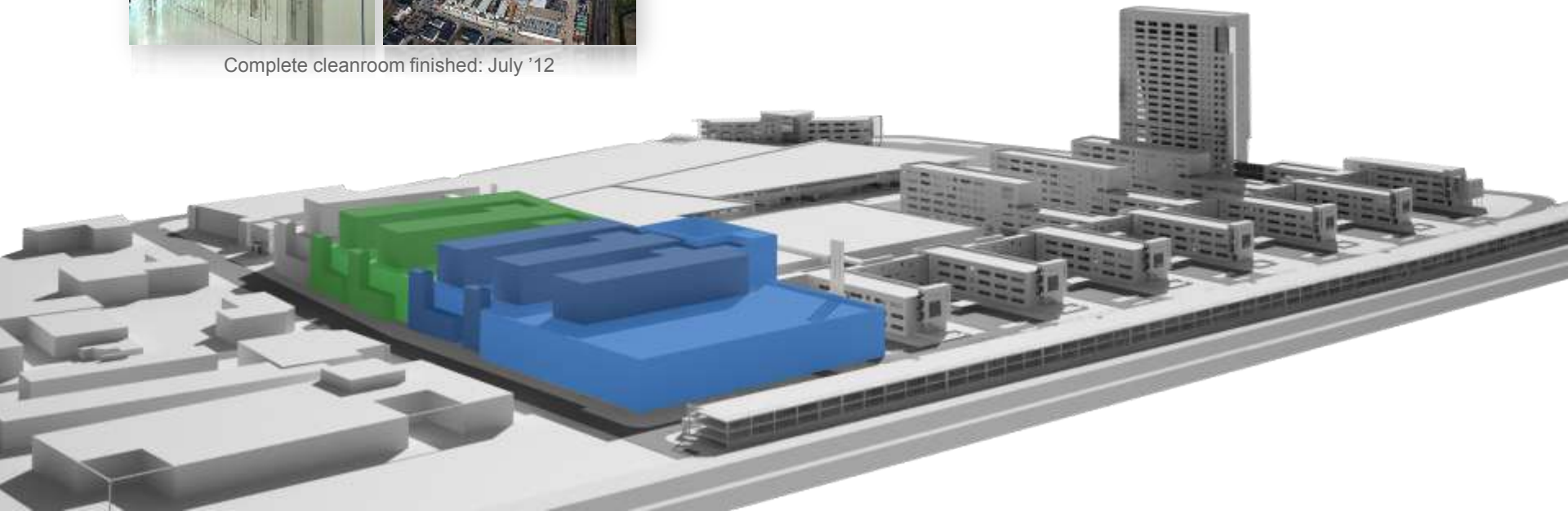
NXE platform continues with the NXE:3300B system

The NXE:3300B extends the NXE platform re-using multiple NXE:3100 modules (stages, handlers, sensors, electronics) but with 0.33 NA for improved resolution, increased transmission for higher productivity and off-axis illumination

Building for volume production

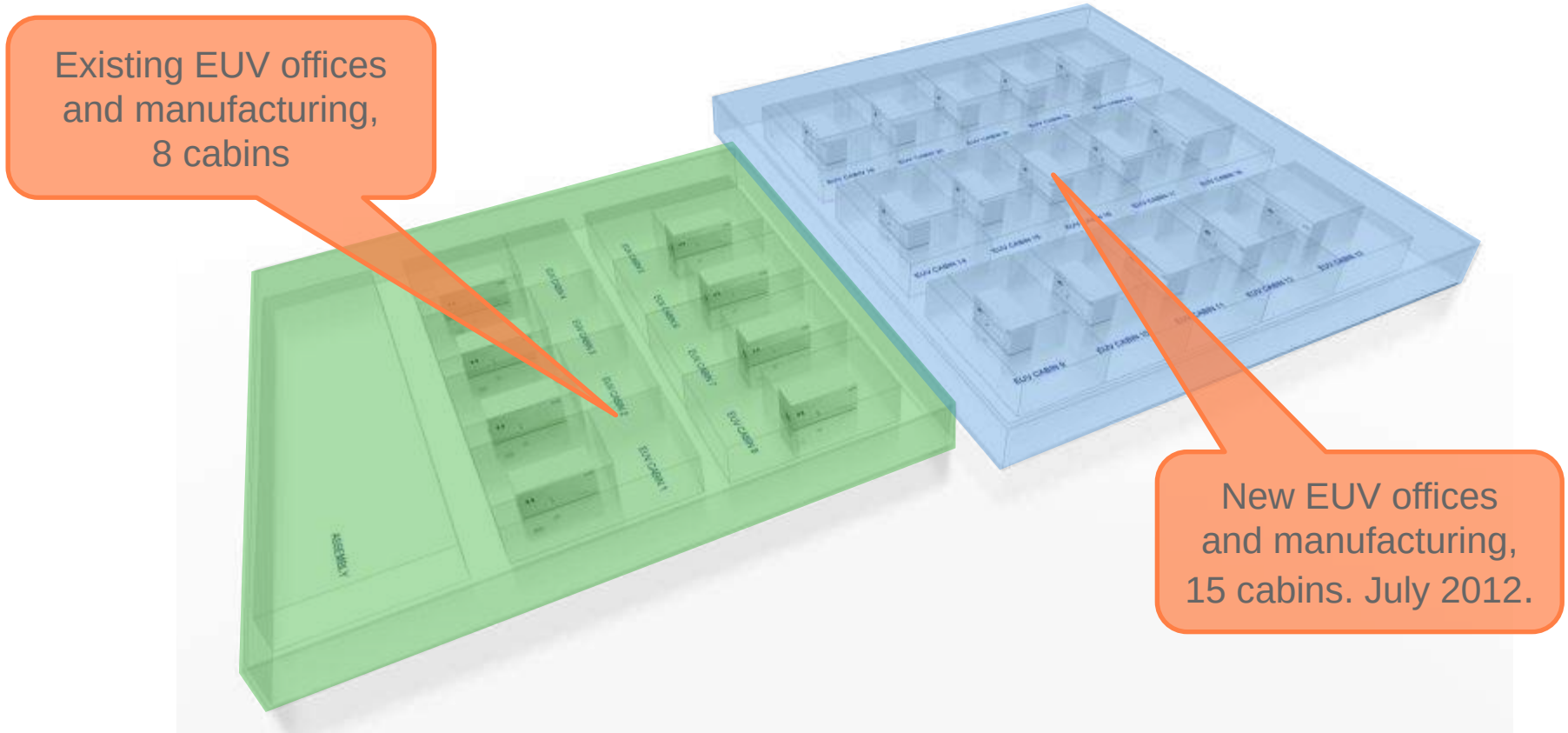
New EUV fab at ASML for 3x capacity increase

Complete cleanroom finished: July ’12



Building for volume production

New EUV fab at ASML for 3x capacity increase



First NXE:3300 lens arrived ASML April'12

Illuminator arrived Dec'11

See presentation Martin Lowisch (CZO)

Contents

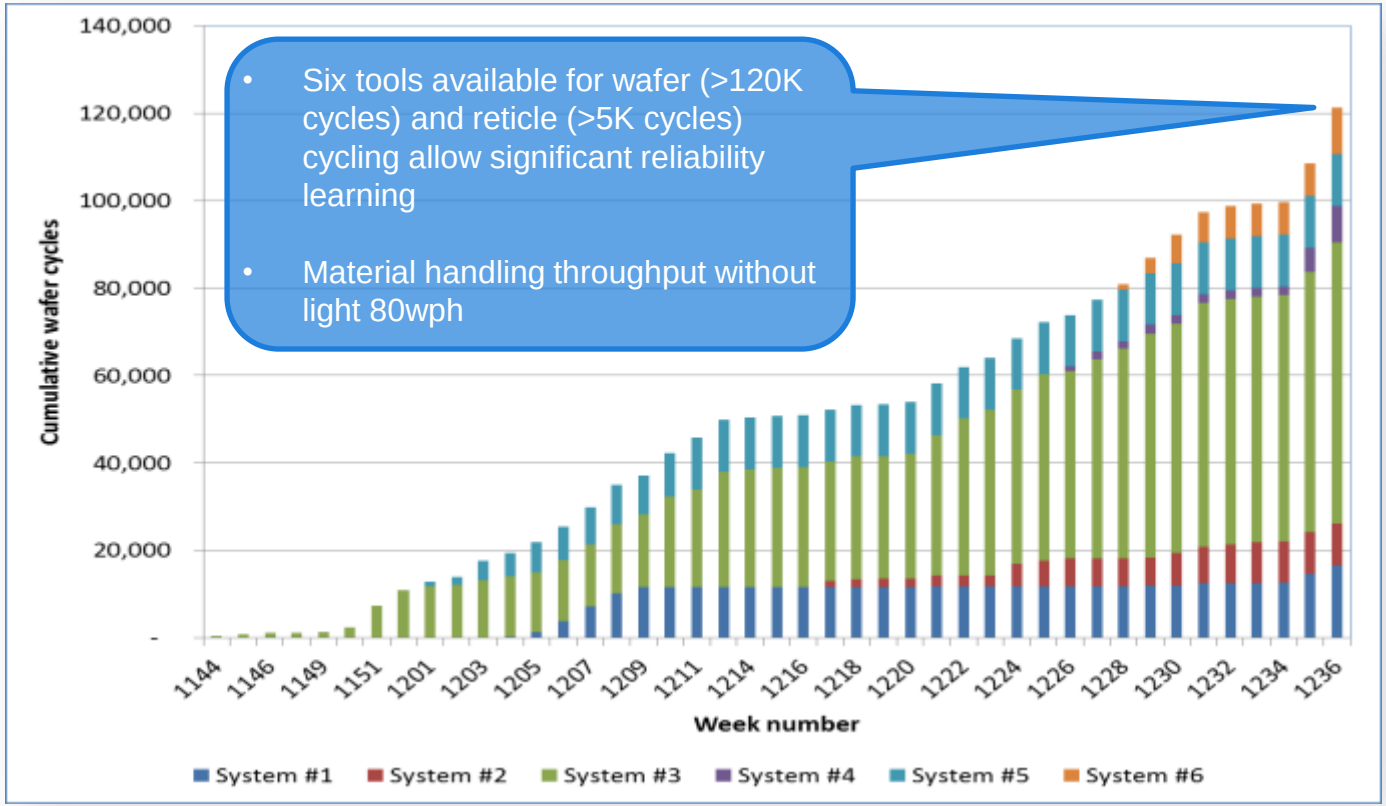
NXE:3100 achievements

NXE:3300B status

- Overview
- **Productivity**
- Overlay
- Imaging

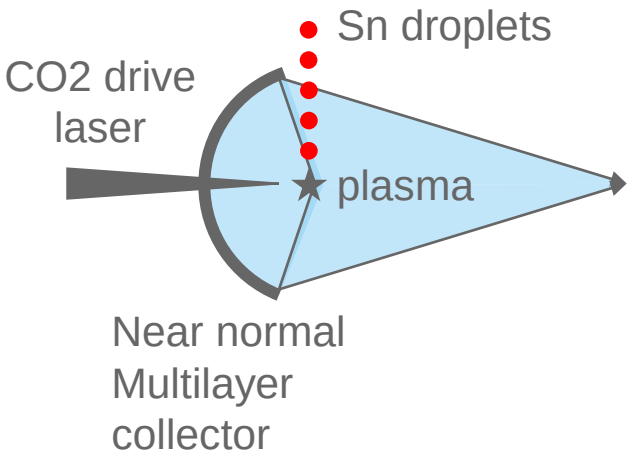
Summary

120,000 wafer cycles for reliability learning



Two EUV source concepts integrated and exposing

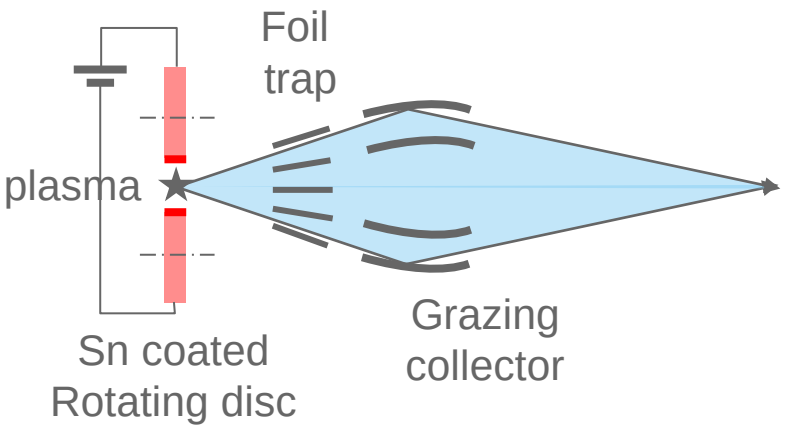
Laser-Produced Plasma (LPP)



- CO_2 laser ignites tin plasma
- Debris mitigation by background gas and possible magnetic field (Giga)

Suppliers: Cymer, Gigaphoton inc.

Electrical Discharge (LDP)



- High voltage ignites tin plasma
- Debris mitigation by rotating foil trap

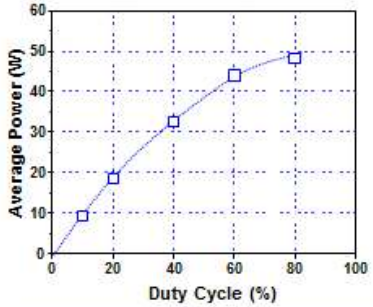
Supplier: XTREME technologies GmbH

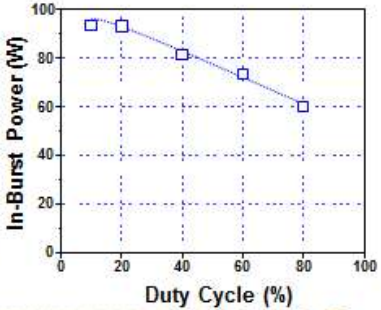
Presentations David Brandt (Cymer), Gigaphoton Inc., XTREME technologies GmbH

EUV source power

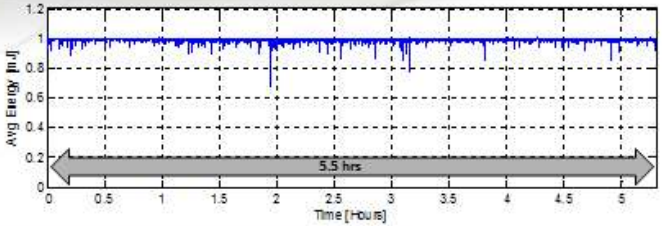
LPP with Prepulse: Capability up to ~50W Average Power at High Duty Cycle Demonstrated

- Prepulse technology demonstrated up to 90W in the burst
- Power roll off (as discussed at SPIE) remains a challenge, new metrology provided learning needed to diagnosis the problem

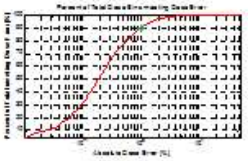




PrePulse Demonstrated with Closed Loop Control over 5 hours of Continuous Operation



- 50W in-burst dose-controlled power at 40% duty cycle (20W average power)
- Energy, timing, and plasma position under closed loop control
- 90% of die better than <1% dose error



Contents

NXE:3100 achievements

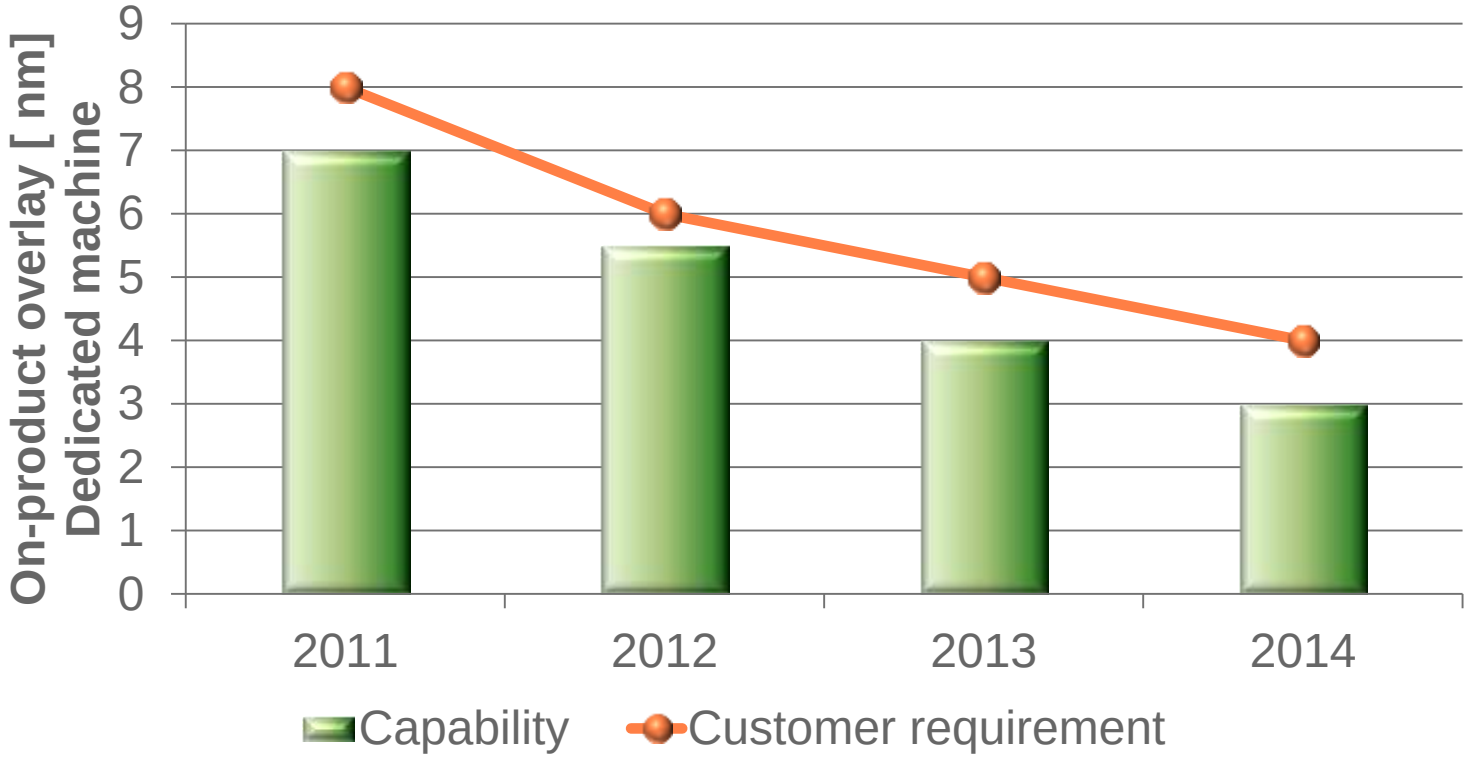
NXE:3300B status

- Overview
- Productivity
- **Overlay**
- Imaging

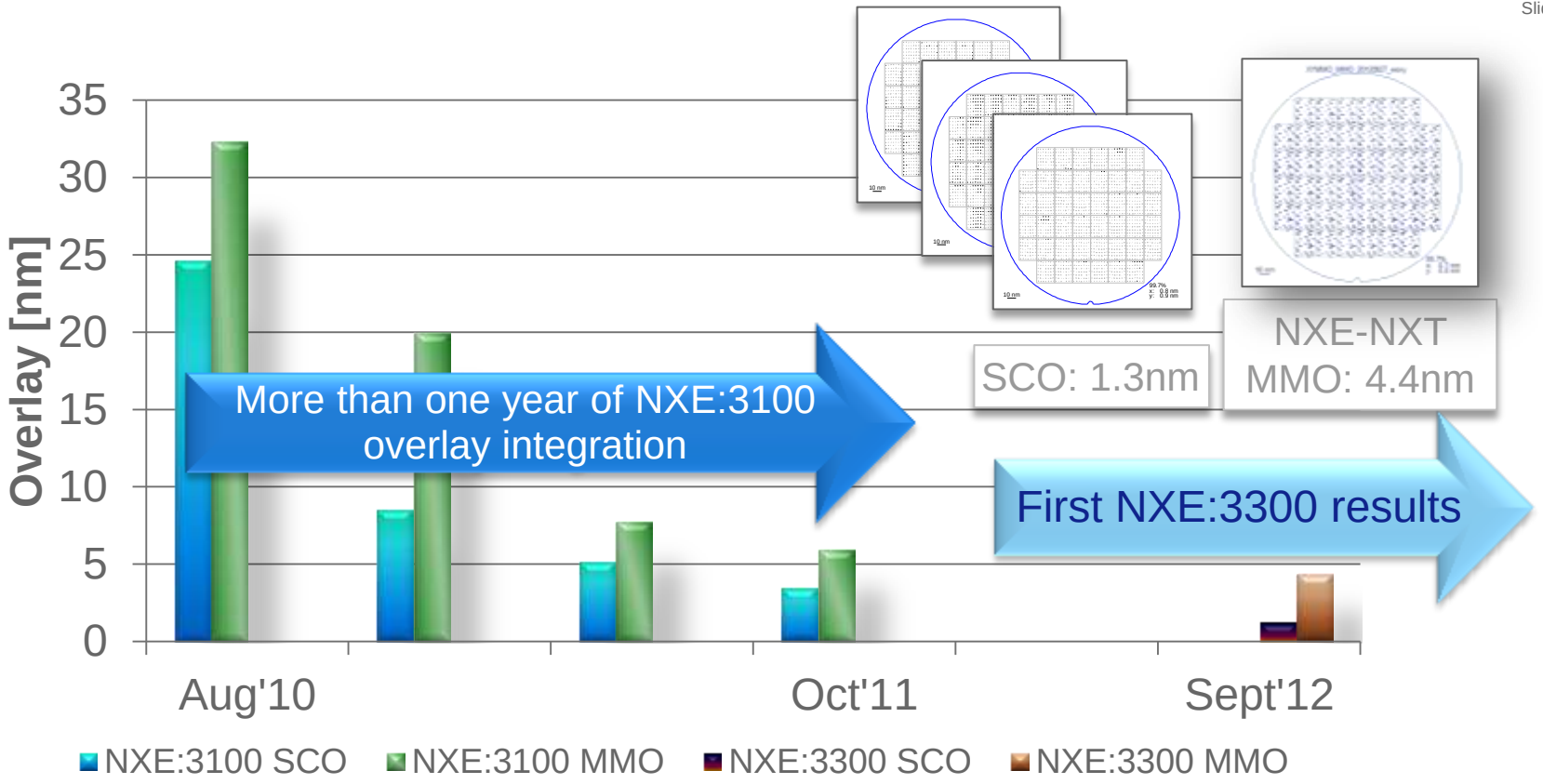
Summary

NXE:3300B supports on product overlay needs

Scanner improvements support tighter on-product overlay requirements



NXE:3100 delivers good initial NXE:3300 overlay



Contents

NXE:3100 achievements

NXE:3300B status

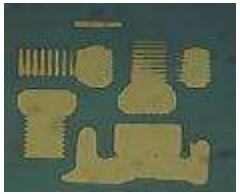
- Overview
- Productivity
- Overlay
- **Imaging**

Summary

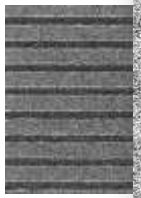
3100 learning accelerates 3300 integration

High resolution 3300 images 2 weeks after first light

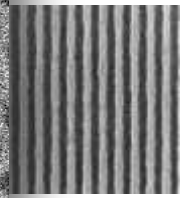
First exposure
July 16 2010



250 n
August



hm small field
ebruary 2012

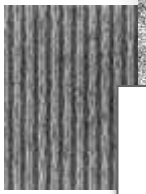


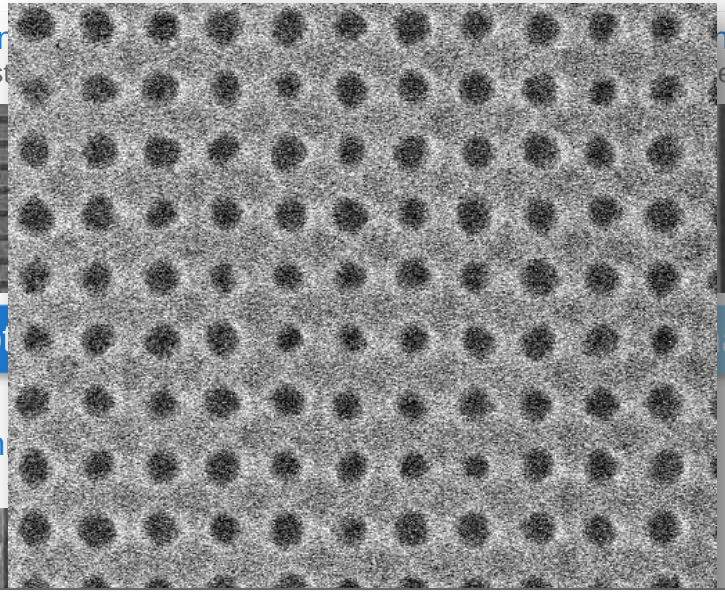
imec

NXE:3100 setup and opt … abled

First exposure
June 20 2012

25 n
July

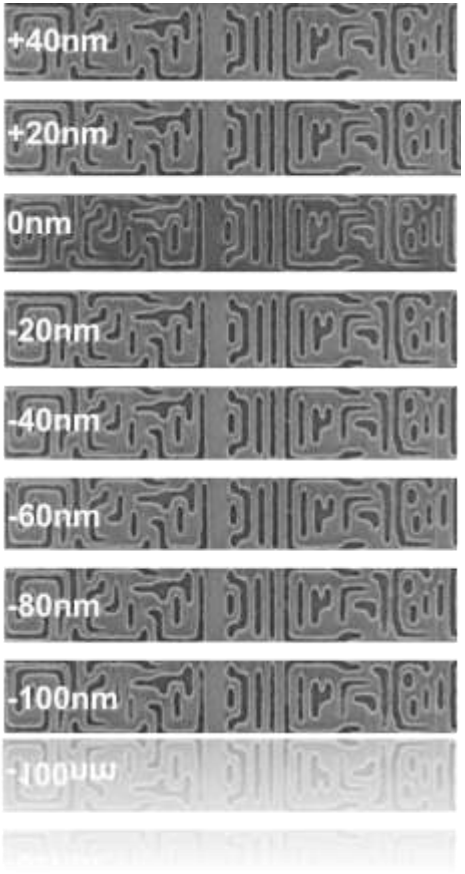


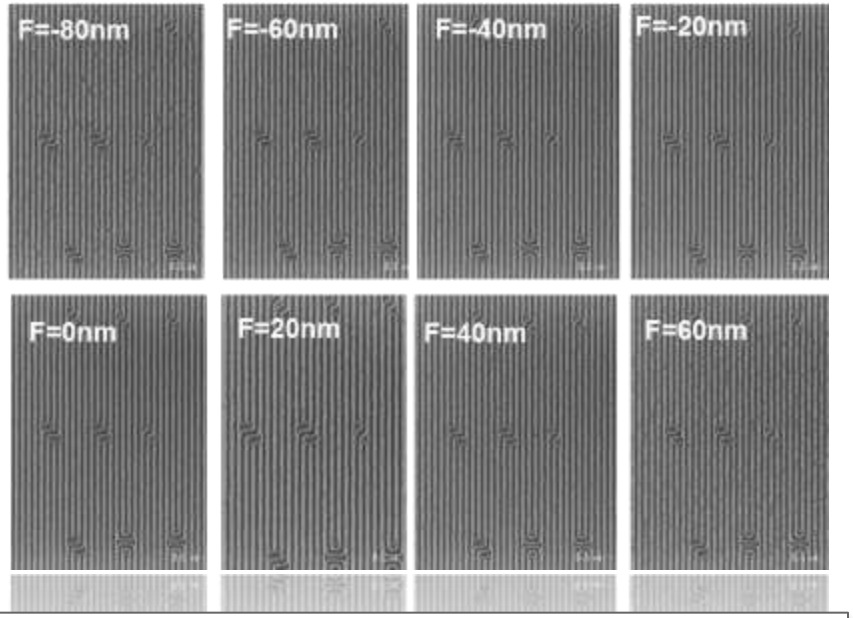


20nm contact holes exposed on the NXE:3300B with quasar illumination

NXE:3300B first ima … abled

NXE:3300B Single exposure 14nm node features





Good printing performance for 14nm node metal layer features (44nm min. pitch) through a large focus range

Contents

NXE:3100 achievements
NXE:3300B status
Summary

NXE program summary

- The NXE:3100 has allowed significant learning for ASML, Zeiss, EUV source suppliers, resist suppliers, other infrastructure suppliers and for chipmakers
- NXE:3100 has established a good performance baseline for the NXE:3300 to build on
- First single exposure images obtained from the NXE:3300B in Veldhoven
  - 20 nm contact holes
  - 14 nm node metal layer structures

Acknowledgements

The work presented today, is the result of hard work and dedication of teams at ASML and many technology partners worldwide including our customers

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ASML